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FROM PHRENOLOGY TO PSYCHOSURGERY AND BACK AGAIN: Biological Studies of Criminality

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Characteristics of scientific research—careful definition of the problem, random sample selection, relevant control groups, careful measurement techniques, and caution in drawing conclusions from the data—are employed to evaluate the argument for constitutional, genetic, mental, endocrinal, and neurological theories of crime causation. A historical continuity in assumptions and methodological flaws is revealed between contemporary studies of the biological correlates of crime and their earlier counterparts. Social and political ramifications of biomedical research are considered.

George Santayana wrote: "Those who do not know history are doomed to repeat it." In light of the present review of the biology of crime, it is more appropriate to paraphrase Santayana: "Even those who know history may *choose* to repeat it." Contemporary studies of the biological correlates of criminality reveal the same basic assumptions and methodological drawbacks as their historical counterparts—concealed only by a refurbishing of terms and technology. Sarbin and Miller [54] have quite appropriately traced a direct lineage beginning with the demonology of possession, continuing through the witch hunts of the Inquisition, finding early scientific rationale in phrenology, and recent expression in hypotheses such as the aggressive XYY male.

The appeal of the recent resurgence of biomedical solutions to crime is multifaceted.[5] First of all, biomedical research funding has been drastically cut, at a time when federal monies for law enforcement are forthcoming. Thus, bio-

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medical researchers are in need of funding, while the state is in search of solutions to crime. Secondly, defenders of the established order find protection in the biomedical approach, which emphasizes individual deficiencies and thus diverts attention from the underlying deficiencies in the social, economic, and political institutions. Finally, the implications of this "unholy alliance" are profound inasmuch as biomedical technology promises more subtle, benevolent, and efficient methods of law enforcement. What was heretofore categorized as punishment becomes treatment, and is thus no longer subject to the legal appeals of "cruel and unusual punishment."

The gravity of this situation requires the utmost in scholarly prudence and political responsibility from the scientific and medical communities. Contrary to expectation, the demonic myth has not dissolved in light of experience, but has remained a lively fiction. It has taken on many guises with respect to criminality—including theories of constitutional, hereditary, mental, endocrinal, and neurological determinism. Examples of this trend will be reviewed from both a scientific and a political perspective. It is hoped that such a reassessment will not only foster more critical scientific efforts, but also greater appreciation for the social and political ramifications of biomedical research.

CONSTITUTIONAL THEORIES

Phrenology

Phrenology—the study of the faculties of the mind from the conformation of the skull—represented an initial effort to relate constitutionally determined structure to behavior. The theory rose to prominence in the earlier part of the 19th century, and many physicians of that era strove to prove that criminal behavior was directly related to specific defects in the structure of the skull.[14] Moreover, phrenology declared an association between specific crimes and corresponding contours of the head. Caldwell [4] asserted that crimes such as theft and murder resulted from the "neglect and abuse of the organs of combativeness, destructiveness and secretiveness" (pp. 101–102).

Coombe [6] maintained that every prisoner should be phrenologically classified, a proposition later embodied in the internationally influential penal code proposed by Edward Livingston. A few American prisons openly associated themselves with the new doctrine and, by 1847, the American Phrenological Journal was able to hail Sing Sing as a "phrenologically conducted institution." [9] The impact of phrenology in criminal diagnoses was also evident in the reports of the trustees of the Eastern Penitentiary at Philadelphia from 1855 to 1865, where criminal behavior was often attributed to phrenological categories.

Criminal Atavism

Cesare Lombroso [38] advanced the doctrine of "criminal atavism," holding that the criminal is born a criminal and is an "atavistic reversal," namely a throwback to a more primitive form of man. Lombroso examined the skulls and brains of criminals and was convinced that primitive stigmata, such as lobeless and small ears, receding chins, low foreheads, wooly hair, scarce beards, and crooked noses were more prevalent in criminal samples.

Lombroso buttressed his theory with a profusion of metric and morphological data. However, his alleged results were presented with faulty methodology and in such a partisan spirit that the work was easily repudiated by exposure of weakness in technique and by citation of contradictory conclusions. The serious methodological objections included: 1) inadequate size of samples; 2) no control data from unbiased population samples; 3) combining diverse ethnic and racial strains as though physically comparable; and 4) lack of a scientific method of statistical analysis.[29] Nonetheless, Lombrosian doctrine became the most influential "scientific" theory of crime through the late 19th and early 20th centuries.

Invalidation of Criminal Atavism

The most thorough and systematic test of Lombroso's concept of the constitutional criminal was undertaken by Goring.[23] Employing Lombroso's critical measures and the services of the eminent statistician Karl Pearson, Goring compared thousands of prisoners (all redicivists) with control groups, including college students and sailors. No differentiating physical characteristics were found, nor could different types of criminals be identified on the basis of physical "stigmata of degeneracy." Interestingly, Goring noted the "startling similarity" betwen the statistics for physical anomalies in criminals and those for the "law-abiding classes."

Revival of Criminal Anthropology

Despite Goring's refutation, constitutional theory was revived when Hooton [29] published the results of a study of 13,173 male prisoners in ten states and of 3203 noncriminals, including patrons of a Massachusetts beach, firemen in Nashville, soldiers, and a few hospital outpatients. Disposing of Goring's study as unscientific, Hooton reaffirmed the Lombrosian position. On the basis of his findings, he asserted that: 1) criminal behavior is a direct result of inherited biological inferiority; 2) particular types of crime are caused by particular types of biological inferiority, as manifested by different patterns of defective anatomical traits; 3) different racial stocks and different national groupings commit characteristic patterns of offenses. Thoroughly convinced of the validity of his data, Hooton made sweeping recommendations:

> It follows that the elimination of crime can be effected only by the extirpation of the physically, mentally, and morally unfit or by their complete segregation in a socially acceptive environment.[25] (p. 13)

Hooton's work has been criticized on the grounds of his basic assumptions, his selection of subjects, his controls, his disregarding of contradictory data, and even for his anthropological criteria.[65] One of the earlier and more trenchant critiques of Hooton's research was presented by Sutherland,[61] and is summarized as follows:

1. Conclusions were drawn from a selected group of criminals in prison, which was an inadequate sampling of "all" criminals.

2. The sampling of the noncriminal group was too small and not comparable with the prison group; firemen and militia members are physically superior to the prison group because they must meet high standards of physical fitness to be instated in these organizations.

3. The conditions of the two groups could not be equated because major intervening variables were not controlled

(*i.e.*, nutrition, occupation, rural vs. urban existence, etc.).

4. The method of translating physical deviations into physical inferiority is not explained.* Unless there is independent evidence of inferiority of certain kinds of physical characteristics, conclusions regarding inferiority must be drawn from the association between criminality and physical deviations. In which case, criminality is used to establish inferiority and inferiority to explain criminality.

5. Hooton argues that physical inferiority is inherited, but this is not substantiated by the data.

6. Hooton's main argument is that social characteristics are not causes of crime unless associated with physical characteristics. In dealing with criminal behavior, there is no logical reason why this proposition could not be reversed.

Constitutional Psychiatry

Shortly after the publication of Hooton's book, another phase of constitutional research was conducted by William Sheldon in the tradition of Ernest Kretschmer. The basic tenets of constitutional psychiatry were that behavior was a function of body structure, and with careful measurement and interpretation, fairly accurate predictions concerning the individual's behavior could be made. Sheldon identified somatotypes, temperamental types, and psychiatric types on a continuum with quantitative variations of the three components described by three quantitative indices. The hypothesis implicit in Sheldon's position is that all variations in personality and behavior will be found to be related to variations in these basic indices.

Sheldon [57] published the results of an application of his theory to the study of 200 "more or less delinquent" males. To test the relation between physical type and delinquency, Sheldon set up a seven-factor index of "disappointingness"—an overall diagnostic impression combining delinquent history with various medical, psychological, and psychiatric factors. The disappointingness index was then correlated with somatotype. The average somatotype of the 200 delinquents was interpreted as mesomorphic (characterized by muscular build). Aside from these findings, the results of the correlation of body type with the traits summarized by the index of disappointingness were either inconclusive or inconsistent. Nonetheless, Sheldon resolved on the basis of his investigation that physical inadequacy was a basic cause of crime and that eugenics offered the best long-term solution to the crime problem.

Sheldon's theories were strongly criticized and his methodology seriously challenged: [17, 62]

1. Delinquency is defined as disappointingness—the criteria for which are not objectively delineated.

2. The population is labeled "more or less delinquent," which is equally undefined. At least 22 of the 200 boys either had no known violations of law or only a few minor violations.

3. The method of scoring is subjective, unreliable, and not likely to be replicated. Individuals are classified by relative scores.

* Indeed Montagu reexamined the combined anthropometric, indicial, and morphological characters studied by Hooton, and concluded that the frequency of "advanced" characters among the criminal series constituted a more advanced group biologically than the noncriminal series.

4. The several varieties of delinquent youth do not significantly differ in their somatotypal and psychiatric indices.

5. The somatotypal and psychiatric indices of the 200 youths do not have evaluative meaning. Sheldon did not show that the location of a particular person or the concentration of a number of persons in a particular area of somatotypal and psychiatric triangles has any relation to social fitness. Thus, the indices do not indicate that the distribution of these 200 youths is worse than that of any other part of the population.

Sutherland [62] reclassified the 200 youths by the seriousness and consistency of their civil delinquencies, using a five-point scale and drawing the information from the biographies in Sheldon's volume. He concluded that the variations in civil delinquencies were not significantly related to variations in Sheldon's indices of constitutional psychiatry.

Physique and Delinquency

Sheldon and Eleanor Glueck [18, 19] attempted to test somatotype theory. Their use of a control group to some extent alleviated the methodological deficiency in the earlier study, and subjects were paired by ethno-racial background. They partially replicated Sheldon's findings insofar as they found: 1) the proportion of mesomorphs among delinquents was nearly twice that of the nondelinquents, and 2) the delinquents contained only one-third as many ectomorphs (characterized by linearity and fragility) as did the nondelinquents. It has been pointed out that the findings that delinquents were more mesomorphic than controls would be contrary to the theory that delinquents are physically inferior.[54] While the predominance of mesomorphs has been attributed to some genetic factor causing both delinquency and mesomorphy, a sociological interpretation that muscular boys are more easily stereotyped as delinquent or more likely to be rewarded for aggressiveness is equally tenable.

Further objections to the isolation of biological factors in crime causation is that there are large numbers of persons in the noncriminal population who exhibit the same deformities, diseases, or disorders claimed to produce criminality. The principle of genetic gradients suggests that whenever an extreme genetic character appears in an individual organism, it should be taken as an indication (unless there is proof to the contrary) that less extreme and graduated genetic characters of the same sort exist in other individual organisms. Indeed, standards of normality are absent to which a criminal biology may be compared.[15]

HEREDITY AND CRIME

The Jukes and the Kallikaks

Studies of the famed lineages of the Juke and Kallikak families by Dugdale [11] and by Goddard [20] supported the claim that some individuals were "born criminals" and that "bad genes" could be passed from generation to generation. Although Dugdale did not invent the Jukes, he often used his imagination when the facts failed to bolster his theory of the hereditary causes of crime. When information about individuals was difficult to obtain, Dugdale resorted to characterizations as "supposed to have attempted rape," "reputed sheep-stealer, but never caught," "hardened character." [43]

Goddard [20] studied the descendants

Table I
CRIMINAL BEHAVIOR OF TWINS

AUTHOR OF STUDY	ONE-EGG TWINS (MONOZYGOTIC) CONCORDANT	DISCORDANT	TWO-EGG TWINS (DIZYGOTIC) CONCORDANT	DISCORDANT
Lange (1929)	10	3	2	15
Legras (1932)	4	0	0	5
Kienz (1936)	20	12	23	20
Stumpfl (1936)	11	7	7	12
Rosanoff (1954)	25	12	5	23
TOTAL	70	34	37	75
PERCENT	67.3	32.7	33.0	67.0

of two clans of the Kallikak family. Although both clans descended from the same Revolutionary War soldier, the "bad" Kallikaks were attributed to the soldier's union with a feebleminded girl. There is little evidence that these families committed actual crime. In fact, Goddard only found three official cases of crime. All of the supposedly "good" Kallikaks descended from the soldier's marriage with a Quaker woman. Montagu [43] points out:

> Since none of the good Kallikaks seem to have inherited any "bad genes", something rather strange must have occurred in the lineage, for we know that a certain number of the good offspring should have shown some "degenerate" traits. (p. 44)

Delinquency and Biological Inferiority

While Goring [23] is largely cited for his effective refutation of Lombroso's doctrine of criminal atavism, he nevertheless maintained that criminality was the result of innate physical and mental inferiority. His conclusions were based on detailed statistical studies in which he found that correlations of criminality among fathers, sons, and brothers were identical with similar correlations among ordinary physical traits or inherited defects. Consequently, he conceived of criminality as inherited in the same manner as a physical characteristic. While Goring attempted to control for some environmental influences, he largely ignored others. In the absence of such controls, his evidence is usually not considered more than suggestive of a linkage between heredity and crime.

Criminality in Twins

The more recent approach to the isolation of hereditary factors in crime is the comparison of identical and fraternal twins. Since monozygotic twins are genetically alike while dizygotic twins are genetically dissimilar, it is postulated that one-egg twins should be more significantly alike behaviorally than two-egg twins. Consequently, if crime is inherited, one could anticipate a high rate of concordance—association of crime in both twins—in monozygotic twins and a low rate in dizygotic twins.

Montagu [45] summarized the findings on studies of adult twins (*cf.* TABLE 1). Concordance is about twice as high as discordance in monozygotic twins. Although these findings suggest a decisive influence of genetic factors, the following methodological criticisms are sufficient to render this explanation highly questionable:

1. The size of the samples used in each study is small. In the Stumpfl study, for example, a shift of two twin-sets

would make the figures for the one-egg and two-egg twins virtually identical (9–9 for the monozygotics, 9–10 for the dizygotics).

2. Differentiation of monozygotic from dizygotic twins was a matter of external observation. It is not possible to determine with sufficient assurance that twins of similar appearance were actually derived from a single fertilized egg.

3. The studies are all deficient to the extent that environmental factors were controlled. Newman [46] pointed out that monozygotic twins are more likely to be exposed to a similar social environment than are dizygotic twins. Consequently, the greater similarity of environment for the monozygotic twins could account for the discrepancy in results.

4. Reckless [51] noted: "If biological determination of destiny is correct, a discordant monozygotic twin set should be impossible, whereas discordant dizygotic sets should be frequent" (p. 186). However, the actual findings reveal that one-third of the monozygotic pairs were discordant. Thus, alternative explanations exist for a high concordance in the criminal behavior of identical twins—explanations which need not invoke heredity.

The 47,XYY Male

The question of whether a man's genetic constitution may be responsible for his committing acts of violence has been the subject of an intensive research effort in the last few years. This renewal of interest in genetic explanations has been generated by the discovery of an apparently disproportionately high percentage of XYY karyotype males in prisons and maximum security hospitals. Jacobs *et al* [31] conducted the first study, which indicated a relationship between an extra Y chromosome and aggressive behavior. Among 197 inmates at a maximum security hospital in Scotland, seven of these males were found to be of XYY chromosomal constitution. This prevalence rate was indeed noteworthy, but it was premature to offer this finding as an indication that 47, XYY males are overrepresented among hospitalized aggressive criminals. For one thing, similar criminality occurs with other karyotypes. Secondly, accurate identification of individual chromosomes is at best extremely difficult insofar as a single chromosome may vary from cell to cell even within the same person.[12]

Jacobs [31] also found that the XYY inmates were unusually tall, with a mean height of 6 feet 1.1 inches. While the bulk of data reinforces the strong association between excessive height and the extra Y chromosome, Kessler and Moos [33] have noted the sampling bias of XYY cases being drawn from families with an initial tendency toward tallness. Although many XYY men are tall, tall criminals do not necessarily have XYY patterns.

The correlation between supernumerary Y chromosomes and violence was accepted uncritically prior to empirical attempts to ascertain the incidence in the population. Owen [48] cited four studies on consecutively born males, involving 7,769 births. Fifteen cases of 47,XYY were reported, a rate four times that previously expected. The composite rate among consecutive newborns is one in 518 births, a rate not very different from that found in penal institutions. Jacobs *et al* [32] provided additional support for this view. Owen concluded:

> Whatever support the "aggressive XYY" hypothesis might receive from a differential rate among prisoners will not be confirmed by this rate of incidence among the newborns—unless they all grow up with a history of imprisonment. (p. 214)

Nevertheless, XYY speculation was not allowed to lie dormant. In 1970, Johns Hopkins University, with financial backing from the National Institute of Mental Health, conducted XYY screening in juvenile detention facilities and in black ghettos.[5] Plans included releasing the results to juvenile courts and correctional agencies. Testing children in public schools and day nurseries were other target areas. In the light of the foregoing discussion, such proposals would appear to be grossly premature and politically ominous.

CRIME AND MENTAL DEFICIENCY

Another theory of causation based upon concepts of constitution and inherited abnormality is that crime is the result of inborn intellectual deficiencies. Fernald [13] provided a classification of feeblemindedness and maintained that every feebleminded individual, especially the high-grade defective, was a potential criminal. Goddard [21] published a list of studies of the intelligence of criminals based on the Binet-Simon scale, in which the study at one extreme diagnosed 89% of the group as feebleminded, the study at the other extreme diagnosed 28% feebleminded, and the median diagnosed 70% feebleminded. Pintner [49] reported a median of 64% feebleminded, as against two to nine percent to be expected in the general population, in a review of sixteen early reports. In a similar study of reports made between 1910–1914, Sutherland [60] found an average of 50% diagnosed as feebleminded. The evidence seemed to provide conclusive corroboration of a relationship between crime and low intelligence.

It was not until World War I, when intelligence scales were standardized on army recruits, and other inadequacies in test administration were discovered, that the estimates of mental deficiency among inmates dropped remarkably.[67] In a comparison of sixteen prewar with sixteen postwar reports, Pintner [49] found the average estimates of feeblemindedness to have shifted from 64% to 26%. In his study of 350 prewar and postwar reports, Sutherland [61] found a similar drop in estimates from 50% to 20%. After carefully equating the methods of various testers, Zeleny [68] concluded that the ratio of feeblemindedness among delinquents to feeblemindedness in the general population was approximately 1.3 to 1. As the postwar evidence continued to accumulate, an increasing number of researchers took the position that the distribution of intelligence among prisoners was roughly similar to that in the general population.[1, 8, 10, 63]

Thus, the isolation of feeblemindedness as a causal factor in crime was not substantiated because of: 1) the upward trend in the proportion of the general population reported feebleminded; 2) the downward trend in the proportion of delinquents reported feebleminded following test standardization; 3) the striking similarity in some studies in the distribution of intelligence among criminal and noncriminal populations; and 4) the fact that delinquents who are tested are likely to include an undue proportion of feebleminded because of the greater probability of arrest, conviction, and commitment to institutions, and the smaller probability of early

Table 2
CRIME AND HORMONE IMBALANCE

CRIME	PITUITARY	PARATHYROID	THYROID	ADRENAL	THYMUS
Robbery and Burglary	+	−			
Murder		− − −	+	+ +	+ + + +
Arson	− −	− −			+ + +

parole. In addition, there is reason to believe that several special factors operated systematically to affect the scores in the criminal samples. For example, offenders were tested either during a period of court appearance or shortly after institutional commitment, neither of which encouraged good rapport with the examiner or strong motivation to perform on the test. Further, the use of verbal test materials to compare the intelligence of delinquents and nondelinquents is inappropriate unless educational levels are equated, and such tests have been shown to be culturally biased.

ENDOCRINE ABNORMALITY

Hormonal Imbalance

Schlapp [55] estimated that one-third of all prison inmates were victims of some form of toxic infection or glandular dysfunction. Schlapp and Smith [56] published a textbook of criminology, which advanced the thesis that all criminal behavior was based on biochemical dysfunction. Berman [2] studied the condition of the different endocrine glands in juvenile delinquents and criminals and concluded:

> 1. Crime is due, in a Gestalt sense, to a perversion of the instinctive drives dependent upon a deficiency and imbalance of the endocrine glands.
> 2. Certain types of crimes are associated with certain types of endocrine malfunctioning. (p. 226)

According to this theory, it merely remained for research to discover specific glandular imbalances associated with specific crimes, and then to supply appropriate hormonal extracts to correct these imbalances. Berman [2] formulated the causal relations presented in TABLE 2.

Podolsky [50] broadened the list of crimes and hormonal imbalances from reported correlations found among prisoners at Sing Sing prison. He also cited other reports purporting to demonstrate that various categories of offenses were associated with hypoglycemia. Instances of "hypoglycemic crime" were said to include theft, violence, traffic violations, clashes with policemen, murder, and child abuse.

Hoskins,[30] an authority in the field of endocrinology, recognized the limitations of an endocrinological explanation of criminal behavior:

> But, before psychology, sociology, and criminology can be convincingly rewritten as merely special aspects of endocrinology, many more facts than are now available will have to be collected and integrated. (p. 348)

Similarly, Montague [44] pointed out:

> Writing now as a student of scientific method, I should venture the opinion that not one of the reports on the alleged relationship between glandular dysfunctions and criminality has been carried out in a scientific manner, and that all such reports are glaring examples of the fallacy of 'false cause' . . . The fact is that as far as the endocrine system and its relation to personality behavior are concerned, we are still almost completely in a world of the unknown, and to resort to that system for an explanation of criminality

is merely to attempt to explain the known by the unknown. (pp. 55–56)

Thus, interpretations of criminality as manifestations of endocrine abnormality were not substantiated because: 1) conclusions were drawn from an institutionalized criminal population which constitutes a limited and selective group of criminals; 2) the physical condition of prisoners was subject to distortion by such special factors as poor diet, restricted physical activity, and unsanitary conditions; 3) normal physiological patterns subject to daily fluctuation were not demonstrated to be constant, so that the figures given by any single investigation were meaningless;[26] and 4) it could just as easily have been argued that psychological dysfunction could lead to endocrine dysfunction and, indeed, the effect of psychological stress upon glandular secretion is more widely documented than the reverse effect of glandular disturbance upon personality.[25, 34]

High Levels of Testosterone Production

Kreuz and Rose[35] attempted to correlate plasma testosterone levels with estimates of aggressive behavior in male prisoners, aged 20 to 35. Although high testosterone levels correlated neither with fighting in prison nor with various psychological tests designed to assess aggressiveness, a correlation was reported with a history of more violent crimes in adolescence. However, there was no difference in the date of onset of more routine crimes such as burglary or petty theft in the high and low testosterone groups. Again, controlled data were not presented to substantiate the hypothesis.

Studies of plasma and urinary testosterone concentration in prisoners have yielded contradictory results. Several studies suggest no changes in plasma levels, but increases in urinary levels.[22]

Other testosterone research suggests that male sex offenders suffer from significantly higher testosterone levels.[5] Several institutions are seeking to do studies in which the progestational compound cyproterone acetate would be given to prisoners. The desired result is that this testosterone antagonist will render these men safe enough to be transferred from prison to half-way houses. Of course, there are no research findings to confirm the assumption that sex offenders in fact suffer from sex hormonal abnormalities.

Contrary to widely held popular beliefs, there are no simple conclusions regarding the relationship of sexual hormones to aggressive behavior. While it is true that aggressive behavior normally involves presence of hormones, absence of hormones does not prevent aggressive behavior. Indeed, the evidence would suggest that hormones are necessary for normal productive psychological development quite apart from sexual or aggressive behaviors. Studies on prisoners and individuals who have committed violent acts have been largely unrewarding, especially because well-designed experiments have not been performed. In regard to sexual hormones, the most convincing evidence suggests that there are powerful learning and social factors related to the manner in which individuals learn to deal with the emotional experiences associated with effects of the hormones.

NEUROLOGICAL DISORDER

Electroencephalographic Studies

There has been a long-standing inter-

Table 3

INCIDENCE OF EEG ABNORMALITY

CATEGORY	PERCENT ABNORMAL
Highly selected flying perosnnel (successfully completed training)	5
Royal Army Medical Corps Personnel	10
Mixed control	15
Mixed psychoneurotics	26
Inadequate psychopaths	32
Aggressive psychopaths	65

est in clinical electroencephalography in the incidence of abnormality found in various psychiatric populations and in criminal offenders. Stafford-Clark and Taylor [59] reported a significant correlation between apparently motiveless crime and electroencephalographic abnormality. Hill and Pond [27] found abnormal electroencephalograms for 70% of a sample of murderers who did not appear to have "good" motives. Hill and Waterson [28] studied the electroencephalograms of criminals labeled psychopathic in comparison with other groups of normal and disturbed people, and their findings are reported in TABLE 3.

Other researchers also have found high incidences of abnormal EEGs in criminals labeled psychopaths as well as in other groups. Ostrow and Ostrow [47] reported the percentages of abnormalities according to diagnostic or legal category (*cf.* TABLE 4). Their study illustrates some of the difficulties in utilizing electroencephalographic data in determining abnormality. For example, by these standards, the conscientious objectors show a higher incidence of abnormality than the psychopaths. The electroencephalogram simply is not as highly standardized an instrument as it is often assumed to be. Interpretations of records are dependent upon judgments of the reporter and vary with theoretical orientation.

Table 4

INCIDENCE OF EEG ABNORMALITY

CATEGORY	PERCENT ABNORMAL
Psychopaths	50
Homosexuals	56
Epileptics	98
Schizophrenics	80
Conscientious objectors	65

There have been other studies which report far lower percentages of abnormal EEGs among criminals. Gibbs, Bagchi and Bloomberg [16] reported that, when age factors and sampling errors are controlled, there are no significant differences between criminals and controls. Levy and Kennard [36] revealed the same proportion of abnormal EEGs (30%) in a group of prisoners and a group of college-aged nonprisoner volunteers.

The potential value of the EEG as an instrument for studying criminal behavior is far from clear. If the assumption is made that violent and aggressive behavior may be associated with electrical changes in the limbic system, then depth electrode evaluation would be the only presently available method of studying this correlation. Yet, the large volume of literature reporting on the findings of depth electrode studies in patients with seizure disorders yields little information directly applicable to a correlation between EEG abnormalities and violence and aggression. Moreover, even if differences between criminal and normal populations could be established, the problem of determining the manner in which electrical changes in the brain could be directly related to legally-defined behavior would still remain.

Epilepsy and Violent Behavior

Epilepsy and violence have long been spuriously equated.[5] Mark and Ervin [40] reported that epilepsy was ten times commoner among criminals than among noncriminals in a survey of 400 prisoners. This does not substantiate a relationship between epilepsy and violent behavior. Gunn and Fenton [24] studied epileptic patients in Broadmoor Hospital in England, and concluded that automatic behavior is a rare explanation for crimes of epileptic patients.

A comprehensive report of 666 cases of temporal lobe epilepsy was prepared by Currie *et al.*[7] Psychiatric diagnosis in these patients showed 56% normal, 19% anxious, 11% depressed, 7% aggressive, 6% obsessive, and 6% severe disturbance of affect. Rodin [52] studied 57 patients with components of psychomotor epilepsy who were photographed during ictus. There were no instances of ictal or postictal aggression. He then reviewed 700 case histories and found 34 patients who had committed aggressive acts. He concluded that the presence or absence of psychomotor epilepsy was not a relevant variable.

Higher incidences of aggression in temporal lobe epileptic patients have been reported. Nonetheless, on the basis of the available literature, Goldstein [22] concluded that violence and aggressive acts do occur in patients with temporal lobe epilepsy, but they are rare, perhaps no more frequent than in the general population.

Episodic Dyscontrol Syndrome

Menninger [41] was among the first to describe what later became known as episodic dyscontrol. More recently, Monroe [42] elaborated on the disorder. Similarly, Lion, Bach-y-Rita and Ervin [37] described their studies in a series of papers and monographs.

The syndrome is characterized by paroxysmal, seizure-like outbursts with an alleged loss of contact with the environment during the outbursts. Mark and Ervin [40] identified the following symptoms: 1) physical assault, especially wife and child beating; 2) pathologic intoxication resulting in senseless violence; 3) impulsive sexual behavior including sexual assaults; and 4) a history of many traffic violations and serious automobile accidents.

A high probability of brain dysfunction is cited as a partial basis for this syndrome. This opinion is based on the frequent history of past head injuries, childhood seizure disorders, abnormal EEGs, and a variety of "soft" neurological signs. An analogy has been made between this syndrome and classical temporal lobe epilepsy—reasoning that dyscontrol may be an example of limbic system abnormality without the features of more conventional psychomotor seizures. However, other investigators disagree with this supposition, and, as mentioned earlier, the whole concept of epilepsy and violent behavior is subject to question.

In particular, the work of Mark and Ervin has received a great deal of attention because they have advocated large-scale programs for controlling human violence and have been awarded funds from various federal agencies including the National Institute of Mental Health and the Law Enforcement Assistance Administration. In individuals whose behavior conforms to the description of the dyscontrol syndrome, Mark and Ervin claim that EEG recordings from the scalp may suggest a triggering focus lo-

cated commonly in the temporal lobes, particularly the amygdala area. Electrical recordings from implanted electrodes in this area are used to help locate pathological brain tissue more precisely. Further anatomical verification is reportedly obtained by noting the location of abnormal electrical patterns triggered by "significant environmental stimuli," which in the past precipitated assaultive behavior. For example, in one case a baby's cry had a high probability of eliciting explosive behavior, so a discrete brain area was sought that responded whenever a record of the baby's cry was played. Additional confirmation of the brain trigger is obtained by precipitating or terminating violent outbursts by electrically stimulating a discrete brain area. After locating the problem area, it is removed by stereotactic surgery, and abnormal behavior is presumably eliminated.

Mark and Ervin's Research

In addition to the criticisms directed to psychosurgery in general, specific flaws in the work of Mark and Ervin have been noted: [3, 64]

1. Although an analogy is made between the dyscontrol syndrome and temporal lobe epilepsy, in most cases, epileptic seizures and psychotic episodes were not eliminated.

2. The likelihood that stimulation and recording techniques, using depth electrodes, can locate specific abnormal brain foci that trigger violence is less certain than Mark and Ervin indicate. Indeed, animal studies suggest that the temperament of the subject may contribute significantly to the response evoked by stimulation, so that sites that commonly evoke pain, fear, aversion, and anxiety may elicit aggression in some patients.

3. Mark and Ervin indicate that multiple abnormal brain foci are common to their patient population, and yet there is a practical limit to the number of sites that can be explored with implanted electrodes. There appears to be considerable trial and error in their method. The site of the destroyed tissue is predetermined by arbitrarily positioned electrodes, and lesions are enlarged until desirable results are obtained. The fact that it is necessary to destroy tissue at several brain sites raises serious doubt as to whether *specific* triggers of violence are being detsroyed.

4. Mark and Ervin cite cases of violence where suggestion of brain damage was popularized (*e.g.,* Whitman, Speck). This is misleading because there is no evidence that brain damage was a cause of the violence or that an amygdalotomy would have been helpful.

5. Despite qualifying remarks, the biological factors as causal agents in violence leads to a neglect of social causes. Consider Mark, Sweet, and Ervin [39] on the role of brain disease in riots and urban violence:

> Is there something peculiar about the violent slum dweller that differentiates him from his peaceful neighbor? . . . we need intensive research and clinical studies of the individuals committing the violence. The goal of such studies would be to pinpoint, diagnose, and treat those people with low violence thresholds before they contribute to further tragedies. (p. 895)

CONCLUSION

Certain hallmarks traditionally epitomize truly scientific research. Among these are: careful definition of the phenomenon under study (tentatively at first, more firmly and clearly as the re-

sult of the research); random selection of the population sample to be studied; employment of relevant controls with which to compare the conditions under investigation or experimentation; careful techniques of investigation and measurement; and caution in the deductions and conclusions drawn from the factual findings. An attempt has been made to illustrate the deficiencies in these respects in the works under review. For the sake of integration and for the purpose of conceptualizing the historical continuity, some examples of common methodological weakness in the literature under consideration will be reviewed:

1. *Careful definition of the phenomenon under study.* In Sheldon's work, for example, a clear definition of delinquency was never provided. Delinquency was defined as disappointingness, which was not objectively delineated. Similar confusion is evident in the work of Mark and Ervin. Although episodic dyscontrol is supposedly analogous to temporal lobe epilepsy without conventional seizures, all their subjects are epileptic patients, and epilepsy is never cured by their surgery. More generally, since most criminal samples in the literature are drawn from penal institutions, criminal behavior in the broadest sense is not under investigation in the work of these researchers.

2. *Random selection of the population sample to be studied.* Almost without exception, selection biases are rampant in the literature. For example, in the early work of Lombroso, it was obvious that he chose his samples according to the presence of primitive stigmata. Consequently, this process would naturally eliminate those subjects who did not conform to his theory. Even with the advent of modern statistics, selection biases are still obvious. Studies on the 47,XYY genotype in male prisoners indicate that individuals with a propensity for tallness and violent behavior were invariably selected as subjects because of the correlation between an extra Y chromosome and height.

3. *Employment of relevant controls to compare the conditions under experimentation.* Lombroso's fatal methodological flaw was that in his effort to assign special physical features to criminals, he limited his studies to prisoners, never collecting controlled data from unbiased population samples. Without controls, the researcher never can be sure to what extent seemingly salient features in the criminal population are prevalent in the general population. For example, with respect to feebleminded-ness, it was not until the First World War, when intelligence scales were standardized on army recruits, that estimates of mental deficiency among inmates dropped remarkably.

In the case of the XYY phenomenon, the existence of this complement in the general population was not investigated until recently. When the incidence of males with chromosomal abnormality was compared to the incidence among newborns, no significant difference was found. Similarly, in procedures as radical as psychosurgery, no attempt has been made to employ nonoperated controls, including subjects undergoing other therapeutic modalities, so that improvement rates are valueless. It is expected that the pacifying effect achieved by surgery would occur in individuals with or without brain dysfunction.

4. *Careful techniques of investigation and measurement.* It was pointed out how Sheldon's method for obtaining

scores of "disappointingness" was relative and unreliable. Indeed, when Sutherland [62] reanalyzed Sheldon's data, he found that variations in delinquencies were not significantly related to variations in Sheldon's indices of constitutional psychiatry. Measurement problems were particularly pointed with the use of intelligence tests to ascertain feeblemindedness among prisoners. On the basis of army tests using the mental-age method, it was found that the true average adult mental age was almost three years lower than the norms previously used.

More recently, the use of electroencephalograms and the presence of "soft" neurological signs to detect neurological abnormality exemplifies contemporary use of unstandardized instruments. Interpretations of the EEG depend upon the judgments of the reporter and vary with his theoretical orientation. In addition, the records are not read "blind"—that is, the person who interprets the EEG record knows the history of the subject. Furthermore, "soft" neurological signs are to be distinguished from "hard" signs; the latter consist of clearly identifiable EEG spikes and slow wave abnormalities, while the former are based on clinical history and suggestive, but not conclusive, types of evidence.[64]

5. *Caution in the interpretations and conclusions deduced from the factual findings.* In the case of the constitutionalists in general, and Hooton in particular, the method of translating physical deviations into physical inferiority is not substantiated by the data presented. Unless there is independent evidence of inferiority of certain physical characteristics, conclusions regarding inferiority can only be drawn from the association between incarceration and physical deviations. In fact, Montagu [44] reexamined the anthropometric, indicial, and morphological characters studied by Hooton and concluded that the frequency of "advanced" characters among the criminal series constituted a more biologically advanced group than the noncriminal series. Overinterpretation can have harrowing consequences, when, as in the examples of Hooton and Sheldon, eugenics is offered as the best solution to the problem. Similarly, despite scant scientific evidence to support Mark and Ervin's theory of episodic dyscontrol, conclusions have been drawn concerning the biological nature of violence and the use of surgical control.

In sum, there appears to be little empirical justification for the remarkable historical resiliency of the biomedical approach to crime. This scientific curiosa suggests that biomedical research serves a powerful latent social function, affirmation of the status quo. Such affirmation may, in the present sociopolitical climate, be all the more reassuring to a public made uneasy by reports of substantial increases in criminal conduct. By lending scientific credibility to what is largely a political statement, the biomedical perspective on crime helps to perpetuate those very social, economic, and political realities in which the phenomenon is embedded.

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